Papers on the Lunar Settlement

General 3 : Location

0. Summary The location selected for the first lunar settlement is a point of great importance. The question is examined based on several criteria.

1. Selection Criteria The decision that the initial human settlement in space should be at Luna leaves a great deal open, since that body has a surface area roughly equal to that of the terrestrial continent of Asia. In order to pick a specific site, we must define the characteristics necessary for a successful settlement, and match them to actual locations. The three criteria which have been identified are subterrestrial orientation, solar-thermal geography, and resource availability. Each of these points is discussed below.

2. Subterrestrial Orientation It appears that the initial settlement ought to be located in the subterrestrial hemisphere of Luna, that is, in an area from which Terra is always visible. With such a location, the settlement itself can remain in constant communication with Terra and vessels in terrestrial orbit, without the need for relays. Additionally, traffic between the two bodies can remain in contact with both of them for the duration of the voyage.

As the initial settlement expeditions will, of necessity, depart from Terra, and as the lunar settlement is expected to be closely involved with industrial development in terrestrial space, this ease of communication is considered a major advantage, if not a necessity.

3. Solar-Thermal Geography In the vacuum environment, the proper management of heat flows becomes a major concern. On Terra, the ambient temperature occupies a range of about 100 kelvins, and the environment has a large heat capacity. Luna lacks both atmosphere and hydrosphere, and so special means must be provided for gaining and losing heat. Paper number 02-04 addresses this topic.

In brief, to enable heat loss during the 350 hours that a point on the lunar surface typically receives direct solar illumination, a large radiating area must be shaded from the sun but open to the sky. This is possible in certain locations. The typical angle of repose of the lunar surface materials is estimated at approximately 50° ; accordingly, above approximately 40° north or south latitude, any long elevated topographical feature running in an east-west direction will have one face either permanently in shadow, or capable of being excavated into such a condition. It is worth noting that, since particle radiations typically travel in straight lines, life forms in this shadow would be largely protected from solar flares.

It would also be possible to raise a berm in the appropriate latitudes, if a suitable geographic feature were not available, but the size necessary to protect the shaded face from conducted heat and edge-on illumination make the raising a formidable task, not suitable for the early phases of settlement. The radiator's effectiveness is largely determined by the temperature of the hemisphere visible from its position, which in practice means the proportion of open sky ; a trench is unsuitable, as the opposite face would reflect or re-emit too much incident radiation, while a prospect over a plain is highly suitable.

4. Resources The decision to settle Luna is based in part upon its possession of a native resource base. Since the settlement will necessarily start small, a location with the greatest variety of resources is most suitable.

The forces which have produced the great ore bodies of Terra, such as hydrothermal action and weathering, have been next to nonexistent in Luna for a very long time. Aside from meteorite fragments, therefore, the occurrence of which may be expected to follow the degree of cratering, the principal mineral resources will be the undifferentiated rock. The rock is of two different kinds, the dark basalt of the maria and the lighter continental rock of the highlands. The difference in colour reflects the difference in composition, so that a site where a very dark basalt meets a very light highland is desirable.

While rich in oxygen compounds, the lunar surface appears to lack volatile substances, including the compounds of hydrogen, carbon, and sulphur, elements needed to sustain life. Some quantity of these elements may be found by sifting the regolith for carbonaceous meteorite fragments, and more by extracting remnant gasses deposited by the solar wind, but a more concentrated source would be very useful in the early stages of settlement. The ultimate solution may be to capture a carbonaceous asteroid, a step not yet practicable.

Some evidence suggests that such a concentrated source is available. Great quantities of organic material are present in the biosphere and lithosphere of Terra, as living things, mould, coal, oil &c. If Luna was originally formed from the same materials as Terra, it must have incorporated the same organic precursors. While, in the course of thousand millions of years, much of this mass may have been lost, some of it should remain.

Observations of the so-called transient lunar phenomena suggest that reservoirs of gas exist beneath the lunar surface. This gas likely consists of helium and argon produced from radioactive decay, with an admixture resembling terrestrial "natural gas", composed of methane, hydrogen sulphide, and the like. Making its way from the lunar interior, gas could be trapped for a time in fractured strata sealed by overlying impermeable rock. Geologists tend to describe the maria and walled plains as just such formations.

5. Conclusion The first settlement should be made in the vicinity of the walled plain or flooded crater Plato. This feature is located on the subterrestrial face of Luna. It lies between 50° and 54° North latitude, and is bounded by a sharp rim wall, 100 km diameter, the southern quadrant of which reasonably approximates a long east-west wall. The plain floor is a very dark basalt ; the rim wall and surrounding landscape are the bright highlands of the Lunar Alps, while the southern rim wall lies on the boundary of Mare Imbrium, and Mare Frigoris is close at hand on the north. The formation appears favourable as a gas reservoir, and transient phenomena have regularly been reported in association with it. Therefore this site appears fully suitable.

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